

## *Fission Battery Initiative Workshop Series*

*Friday, April 16, 2021*

*10:00 a.m. – 4:00 p.m. (Eastern Time)*

### **Fission Battery Initiative Workshop Series**

#### **Safety & Licensing Workshop**

**The initiative envisions** *developing technologies that enable nuclear reactor systems to function as batteries and to be referred as fission batteries.*

Safety and licensing aspects of fission batteries are very important since many of the technologies would be disruptive and is expected to have new features to be addressed in safety analysis and licensing process such as simplified design to be mass produced in factories with standardized sizes, reliable performance, autonomous controls and unattended operation, remote monitoring technologies etc.

---

The objectives of this *Workshop* are to understand the challenges and gaps that exist in developing:

- Computational and validation tools needed for fission battery safety analysis and confirmatory regulatory evaluations;
- Approaches for preparing fission battery safety analysis reports and initial license applications;
- Implementation of design control practice defined in ASME-NQA-1 to fission battery safety analysis and report.

The expected outcomes of this workshop are to identify research and development required to perform fission battery safety analyses and evaluations; to propose graded preparation approach and content of the fission battery safety analysis report; to establish the technical bases for licensing and operation of unique fission battery features; and to establish and implement processes to control the design and design changes of items that are subject to the quality assurance requirements.

---

## INL & NUC POC:

Jason Christensen  
Idaho National Laboratory

Maria Avramova  
North Carolina State University

Dean Wang  
The Ohio State University

## Local Organizers:

Scott Palmtag  
North Carolina State University

Mihai A. Diaconeasa  
North Carolina State University

Jason Hou  
North Carolina State University

### ***Session 1: Modeling and Simulation of FB Safety***

Session 1 will address which modeling and simulation tools to be used to analyze and understand the performance and behavior of FB safety. The objective is to identify a validated and verified, tightly integrated group of multi-physics modeling and simulation codes for FB safety analyses and evaluations.

### ***Session 2: Safety Design Basis and Strategy for FB***

Session 2 will focus on comparing deterministic vs. risk-informed and performance-based approaches. The objective is to compare these approaches and to focus on the graded approach, which encourages the preparation of safety analyses that justify the selection of accident scenarios, the level of analysis detail and scope of documentation from a combination of risk- and performance-based evidence. In this context, the content of the FB safety analysis report will be discussed.

### ***Session 3: Licensing and Regulatory Research for FB***

Session 3 will discuss how to develop technical information, data, and knowledge that can support both industry and the regulators for an initial license application. The objective is to establish the technical bases for licensing and operation of unique FB features including control systems and strategies for autonomous and semi-autonomous FB control.

### ***Session 4: Design Control of the Design-Basis Envelope for FB and Support for DOE's Authorization Process***

Session 4 will address the design control practice defined in ASME-NQA-1, where it is common to distinguish documents prepared for a nuclear facility safety case. The objective is to satisfy the DOE Quality Assurance Requirements as well as to establish and implement processes to control the design and design changes of items that are subject to the quality assurance requirements.

US NRC and DOE criteria and guidance for developing the overall safety basis, leading to the preparation of a documented safety analysis report for FB will be discussed.

## Opening Session (Moderator: M. Avramova, NCSU)

10:00-10:20    Opening Statement and Introduction..... Vivek Agarwal  
*Idaho National Laboratory*

## Session 1: Modeling and Simulation of FB Safety (Moderator: S. Palmtag, NCSU)

10:20-11:35    Evaluation Model Content for New Reactor Licensing ..... Robert P. Martin  
*BWX Technologies, Inc.*

Industry Approaches for Microreactor Modeling and Simulation  
..... Bradley T. Rearden  
*X-energy*

Transient Modeling and Safety Issues of Fission Battery Reactors ..... T.K. Kim  
*Argonne National Laboratory*

Highlights on MOOSE Capabilities for Safety Analyses of FB ... Nicolas Martin  
*Idaho National Laboratory*

11:35-11:45    Break..... 10 Minutes

**Session 2: Safety Design Basis and Strategy for FB.  
Content of FB Safety Analysis  
(Moderator: M. A. Diaconeasa, NCSU)**

11:45-1:15	NRC Perspectives on the Safety and Licensing of Fission Batteries ..... Jan Mazza & Martin Stutzke <i>U.S. Nuclear Regulatory Commission</i>
	Licensing Issues for Fission Batteries: Working INSIDE the Box ..... Ronald Ballinger <i>Massachusetts Institute of Technology</i>
	Perspectives on the Role of PRA in Fission Battery Development.....Karl Fleming <i>KNF Consulting Services LLC</i>
1:15-1:45	Lunch Break..... 30 Minutes

**Session 3: Licensing and Regulatory Research for FB  
(Moderator: J. Christensen, INL)**

1:45-2:35	Developments in Digital Twins: Applications to the Future of Fission Batteries ..... Christopher Chwasz <i>Idaho National Laboratory</i>
	Proposed Licensing Basis for Fission Battery Reactors - Three Critical Issues ..... Richard Denning <i>The Ohio State University</i>
2:35-2:45	Break..... 10 Minutes

## Session 4: Design Control of the Design-Basis Envelope for FB and Support for DOE’s Authorization Process (Moderator: J. Hou, NCSU)

2:45-3:50	Overview of U.S. DOE Authorization Pathways .....	Thomas Sowinski <i>U.S. Department of Energy, Office of Nuclear Energy</i>
	Preparation of Safety Basis Documents for DOE Authorization of FB .....	Jason Andrus <i>Idaho National Laboratory</i>
	DOE Safety Authorization Process for New Reactors .....	Charles Maggart <i>U.S. Department of Energy, Office of Nuclear Energy</i>
3:50-4:00	<b>Outcomes &amp; Closing Remarks</b> .....	Jason Christensen <i>Idaho National Laboratory</i>